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The Impact of Prior Knowledge on Team Development

Mark Handel, Paul R. Jackson, and Marie Murray
The Boeing Company

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14. ABSTRACT *(Maximum 200 words)*:

Successful teamwork requires development of trust (as well as appropriate distrust) among the team members, and understanding how trust develops in newly formed teams is essential for the development of new team-building methodologies. Research on trust formation in teams has primarily been conducted in either a lab or a classroom, which ignores factors important in the real world such as reputation/prior knowledge of teammates, knowledge of the role played on the team, and knowledge of processes and routines to support the team. We conducted research to understand the impact these factors play in team development in emergent, ad-hoc, geographically distributed teams. We found that organizational tenure had a slight negative effect in trust development, prior knowledge of team members had no effect, and an ambiguous relationship was found between processes and tool knowledge on team development. We concluded our research with some observations about project versus process teams.

15. SUBJECT TERMS

Team members, role understanding, process knowledge, trust formation, leadership, work experience

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Mark Handel, Paul R. Jackson, and Marie Murray
The Boeing Company

Basic Research Unit
Paul A. Gade, Chief

U.S. Army Research Institute for the Behavioral and Social Sciences
2511 Jefferson Davis Highway, Arlington, Virginia 22202-3926

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THE IMPACT OF PRIOR KNOWLEDGE ON TEAM DEVELOPMENT

EXECUTIVE SUMMARY

Research Requirement:

This research was conducted by the Phantom Works Organization within The Boeing Company under contract to the United States Army Research Institute for the Behavioral and Social Sciences (ARI). This research was based on a proposal submitted in response to the ARI Broad Agency Announcement, BAA DASW01-04-R-0001.

It's not clear that we know a good deal about how individual factors such as extroversion and cultural factors (e.g., obedience to authority) impact team formation. By the time individuals start working in teams, these factors are more or less constants. Are there factors that can be trained prior to team formation or used to determine team make-up? This research looks at four relevant factors: prior knowledge of and/or experience with team members; process and tool knowledge; knowing the roles and responsibilities of teammates; and, understanding team success. If these factors are shown to have an impact on the performance of teams, it makes sense to target appropriate training and adjust team selection factors

Both the U.S. Army and The Boeing Company must be able to establish high performance teams quickly, even when team members are widely distributed geographically and work for different organizations. These organizations may even compete for resources or responsibility. Successful teamwork, especially among distributed, diverse organizations, requires developing trust (as well as appropriate distrust) among team members. Understanding how trust develops in newly formed teams is essential for the development of new team-building methodologies.

Procedure:

The research was conducted using newly formed, geographically distributed and collocated teams at Boeing. Once a candidate team was identified, generally by the team's manager, the team was evaluated to ensure that it was following an established process, and that the members of the team had not worked extensively with each other previously. The team members received two surveys to complete, either electronically or on paper. The first survey was administered shortly after the team's formation, and the second survey was administered 4 to 6 weeks later. The two surveys were nearly identical, and had questions pertaining to tenure at the company and prior work experience with teammates, team processes and tool knowledge, understanding the roles other team members played, and a standardized trust inventory. Short interviews were conducted with at least one member of each team to understand team interaction and individual motivation.

Findings:

The findings were inconclusive. It was difficult to find the type of team specified in the project plan, because the organization we were studying (i.e., Boeing) generally formed teams of people who knew each other and were collocated. Also at Boeing, the teams were more project- than process-oriented; they were formed in an ad-hoc manner to accomplish a specific goal. Even so, the levels of trust we found were lower than anticipated.

There is evidence that tenure at the company has a negative impact on the development of trust, which was unexpected. It seems that the longer employees have been at the company, the more negative they are, as team members, about team participation. In spite of this negativity, team goals were met.

Regarding process and tool knowledge, we found that knowledge of tools had some positive effect on team development, but knowledge of the overall business goals seemed to inhibit trust development. We found no support for role knowledge helping the team to develop trust.

Utilization and Dissemination of Findings:

The recommendation of this research is that increasing training on process tools used for the team prior to team formation is generally beneficial to improving team trust. Based on the other findings, additional recommendations are not conclusive. It may be that a distinction between projects (one-off endeavors) and processes (repeatable sets of actions) needs to be made: The teams observed in this research were essentially project teams and the research design was primarily geared to process groups.

As the research was done, a deeper understanding of two kinds of organization units was developed: project teams and process groups. Project teams are units put together to execute a one-off project, and then are dissolved. On the other hand, a process group stays together to carry out a repeatable, on-going process. A follow-on research project would explore the differences between these two kinds of groups, in particular, looking at how the factors identified in this work impact the development and integration of individuals into the two kinds of organizational units.

THE IMPACT OF PRIOR KNOWLEDGE ON TEAM DEVELOPMENT

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Introduction

Rapid formation of high-performance teams is a critical requirement for both the U.S. Army and for U.S. industry, and factors that contribute to team formation and productivity have been the subject of considerable research. Expected outcomes of this research were a better understanding of the conditions that enable rapid team formation, insight into best practices for team formation and team leadership, and an understanding of the contribution of organizational routines and processes to team formation.

Much of the research on teams has been conducted in university settings, using ad-hoc teams composed of students. We have learned much about the development of trust within teams from this research, but it remains uncertain whether the factors that contribute to trust in laboratory experiments apply to newly formed teams in the real world. The participants in laboratory studies generally have little or no prior knowledge of each other and do not expect to work together in future teams, In addition, these teams lack established processes, procedures, or tools that would expedite and structure their work. Even in studies of real-world teams, the nature of the temporary teams used often eliminate crucial factors, such as prior work experience or the expectation of future work (Meyerson, Weick, & Kramer, 1996).

Real world teams may or may not be formed in this vacuum of knowledge with respect to team members, roles, or processes. Team members may have worked with their teammates on prior projects, and may work with them in the future. Even in the rare cases of no overlap, team members may draw on their social networks to determine various reputation factors about their teammates, and especially their leader(s). Teams are not put together solely to fulfill a headcount, but to ensure coverage of various skill sets and knowledge. Additionally, in most organizations, there is an extensive body of processes and procedures that are both implicit and explicit, implemented to facilitate team and individual activities.

This report is the result of investigating real world teams collaborating on long-term (weeks to months) projects. The teams used were newly formed teams in The Boeing Company. This effort was conducted during 2008 using teams in the Phantom Works Organization, by investigators in the Boeing Engineering, Operations & Technology, Phantom Works, and Networked Systems Technology Organization.

Prior Work and Overview

Prior Work

This research extends the notion of cognitive trust beyond being defined as solely a measure of competence and reliability. Here, we are hypothesizing the existence of another aspect to cognitive trust, which could be called organizational understanding. Organizational understanding is suggested in part from prior research on transactive memory (Hollingshead, 2001). We operationalize organizational understanding here as a combination of role familiarity (both the individual's role in the team and teammates' roles), process knowledge about how the team will be run, and expected deliverables of the team.

Research Team

This research was conducted by the following team members:

Mark Handel, PhD, Principal Investigator, Networked Systems Technology
Paul R. Jackson, PhD, Investigator, Networked Systems Technology

Marie Murray, Manager, Networked Systems Technology

Overview of the Research

The core hypothesis of this research is that *prior knowledge impacts team performance.* In the context of this research we have a fairly specific definition of prior knowledge. It is made up of three specific factors:

- Prior work experience with teammates,
- Experience with team processes and procedures, and
- Knowing roles and responsibilities of the other teammates.

We believe that increased levels of these factors should allow a team to coalesce and establish higher levels of trust. The benefits of these factors are that processes and tools are trainable prior to team formation and company and teammate history is measurable prior to team formation. In short, individuals can be prepared for teams before the team is formed, and the team can be structured for success.

Research Questions

We identified three fundamental research questions about the factors that influence the development of team trust:

RQ1: Does having prior work experience with teammates help improve overall team trust?

RQ2: Does having good knowledge of the process and procedures the team will be following help improve overall team trust?

RQ3: Does knowing the roles and responsibilities of the other members of the team help improve overall team trust?

Methodology

Survey Design

The survey tool is attached in Appendices A and B.

Prior Company and Teammate History

For history with the company, a simple 5-point scale was used, measuring non-overlapping year intervals. For each person on the team, each respondent was asked about their prior work experience with that person. This also was done on a simple scale, although the measures were purely qualitative, and required some thought on the part of the respondent. However, no one reported problems answering the question, and of those completing the survey, the response rate was nearly perfect.

Process Knowledge

In both the initial and final surveys, there was a fifteen question inventory on process and tool knowledge. The inventory covered five general areas:

- Knowledge of the overall process,
- Business purpose of the process,
- Ability to execute the process,
- Prior training on the process, and
- Tools provided for the process.

The inventory was formulated as a set of statements related to the areas, and the respondent used a five-point Likert scale to agree or disagree with the statements. The areas were selected based on experience with how internal business processes were developed and implemented at the company. The tool questions were formulated broadly to cover specialized computer systems, forms, and ad-hoc tools such as excel spreadsheets.

Team Design/Role Understanding

For role understanding and team design, we collected and evaluated answers to two questions:

- How well does the individual know the roles that other people are playing? (team understanding)
- How well do the other team members know the role the individual is playing? (role understanding)

To understand these factors, each respondent was asked first what their role on the team was, and second, their best understanding of the role of each other person on the team.

Based on these answers, a matrix for each team was constructed: along the x-axis is each member of the team and along the y-axis is each respondent. The matrices are generally wider than tall, because not every member of the team responded to the survey. In each cell, one of three values was assigned: 1 if the respondent's role assignment matched the actual role the person played, 0 if the role assignment did not match, and no value for the identity relationship (same person). There was a fair amount of variation between self-reported role, actual role, and the perceived role by others. Self-reported role and actual role were generally reconciled by using the most specific and powerful role. In all instances where the actual role was changed significantly, it was because the respondent lessened their importance (e.g., people characterized themselves as a contributing member, when in fact they were in a management position in the team).

Figure 1 shows an example of the worksheet used to develop the measures. For instance, the .33 at the bottom of the column labeled R4 indicates that Respondent 4's role understanding was only .33 (i.e., 1/3 of other respondents knew R4's role on the team). The 1.00 at the end of the *row* labeled R1 (Respondent 1) indicates that R1's team understanding was perfect (i.e., R1 knew the role of every member of the team).

	R1	R2	R3	R4	Team Understanding
Self Report Role:	Team Lead	Budget Rep	System Designer	Technology SME	
Actual Role:	Team Lead	Estimator	System Designer	Technology SME	
Respondent					
R1		Finance Rep	WIDGET Designer	XML Expert	
R2	Manager	Me	Contributor	Not Sure	
R3	Team Captain	Contributor		Tech Person	
R1		1	1	1	1.00
R2	1		0	0	0.33
R3	1	0		0	0.33
	1.00	0.50	0.50	0.33	

Figure 1. Example of role and team alignment worksheet.

In addition, because these were free-response fields, the respondents' identification of the roles played was generally slightly different from the actual role played. In these cases, a liberal

policy of matching was applied. Both obvious non-understanding of the person's role and uncertainty about the point of the question were coded as0. Where the benefit of the doubt could be applied, it was coded as a match. This was one of the more misunderstood questions on the survey; it was one of the few free-response questions, and for many people "team role" may not be a well-defined concept. Some of the issues around process roles are explored in the discussion section.

Trust

The trust measures were taken from McAllister (1995). This is a standard trust inventory, and has been used in studies similar to this study. The inventory has 14 items; each item is scored on a five-point Likert agreement scale, with two items reverse-scored. The inventory measures two types of trust: cognitive trust and emotional trust. In the analysis of the results, the combined (averaged) overall trust score was used.

Team Selection

The goal of the project was to find six teams that met the following criteria:

- Geographically distributed;
- Between 6 and 15 members;
- Had not worked together in a significant fashion prior to this team; and
- Were following an established process.

For geographically distributed teams, the goal was to have teams that had to create formal mechanisms for collaboration. If the team was collocated, it might be possible for all of the collaboration to take place via ad hoc meetings and opportunistic encounters. In addition, collocation would greatly increase the chances that the team members had previously worked together or knew each other prior to the team being formed.

The size of the team was limited so that the team members would have a good chance to know everyone on the team. A team much larger than 15 or so would mean that there would be a good chance that there would be sub-teams or small groups that did not interact with the rest of the team. It also would have made the survey instrument (name lists) much larger, and possibly reducing the number of participants.

The last two criteria were instrumental to the underlying research questions. The goal was to find people who had some knowledge, but not detailed knowledge, of their teammates (RQ1). By filtering out teams that had extensive prior knowledge of each other, we could ensure some variability in the independent variable. The other goal was that the teams were all put together to follow an established process. This is in support of RQ2.

Initially, the plan was to use Boeing Commercial Research and Development (CRAD) capture teams. These teams are formed in response to an external funding opportunity; for example, a military research group soliciting research proposals. There is a formal business process that is followed, documenting five "gates" that must be met for the CRAD proposal to go

forward. Each gate has a defined set of deliverables and forms to be completed. The gate consists of a meeting (generally a telecon to include remote team members) to review the deliverables and then to make a yes/no decision as to whether to proceed.

The proposal teams were solicited through a number of people within the organization, including managers for various groups, procurement agents, and business development groups. In addition to the proposal teams, there also was a general request to identify newly formed teams to participate. Identifying teams was significantly more difficult than we expected: Teams meeting all four criteria listed above were not as prevalent as previously believed. In addition, it was difficult to find teams that were in the formation stage and had not been in existence for some time. Nine teams were identified over the course of the investigation. Of those teams, the leads of three of the teams declined to allow their team to participate in the survey at various points in the survey process. One team did not meet the criteria (significant prior work experience), and one team had only one responder to the survey. That left only four teams covering 32 individuals making up the research population. See Table 1 for details.

Table 1

Team Identification and Survey Outcome

Opportunity	Research outcome
P1	Manager refused participation
T1	Successful (6 subjects, 5 complete respondents)
T2	Successful (6 subjects, 4 complete respondents)
P2	Minimal response to survey
P3	Did not meet criteria
T3	Successful (9 subjects, 5 complete respondents)
T4	Successful (11 subjects) Minimal T0 response (1 response), good T1 response (7)
P4	Manager refused participation
P5	Manager refused participation

Interviews

In addition to the surveys given to all members of the team, interviews were conducted with selected members of the teams. These were open-ended interviews, designed to get a sense of how the team was formed, what the team did, and to try to identify any significant factors about how the team came together that was not elicited through the survey. The interviews were scheduled for 30 minutes each and most of them lasted about that length of time. A few interviews were longer, based on the respondent's openness to continuing it. Notes were taken during the interviews to capture the major themes and provide a few direct quotes. After the interview, the notes were reviewed and major insights were recorded.

Results

Prior Work Experience: Company and Teammates

Prior Experience With the Company

The respondents have been with the company for a long time. Only four of the respondents had been with the company less than 10 years; and only one had been at the company less than 3 years. The remaining 82.6% of the respondents have been with the company for 10 or years or longer. We were unable to obtain the distribution of workforce tenure for the company as a whole or for the business unit where the work was performed. Based on the authors' experience at the company, the population is skewed towards more experience with the company. Without company-level data, it is hard to tell if this is a significant skew or not.

Table 2
Length of Employment

Length of employment	Number	Percent
Less than 3 years	1	4.3
3-5 years	1	4.3
6-10 years	2	8.7
10+ years	19	82.6

Intuitively, longer employment at the company could be expected to result in higher scores in several factors: prior experience with teammates, and more process and role knowledge. Trust, too, might be affected—if individuals cannot trust coworkers, there might be a greater propensity to leave the company. However, we found no significant correlations between tenure at the company and the other factors.

Prior Experience With Teammates

Overall, the teams had a fair amount of prior experience with one another. Table 3 breaks out the average prior experience. Team 1 was the most familiar with their co-workers, with an overall average of 4.82. Team 2 and 3 were less familiar with each other, but most of the members had at least some work experience with their co-workers.

For both Team 2 and 3, there were clear outliers in previous work experience. For Team 2, this seemed to be two newer people who the other four people were not as familiar with. These two people were also the non-responders to the survey, so it is unclear to what degree they also did not know the other people in the team. For Team 3, there was one person who was clearly less known to the team, and who knew the other members less well. Eliminating this person in Team 3, the average prior work experience increased to 4.1. Team 4 had the least amount of prior work, and also had the largest number of remote team members (50%), and the largest number of sites (a total of three). Not surprisingly, the remote team members had a lower average experience than the main contingent, who were collocated.

Table 3
Prior Experience With Teammates

Team	Prior teammate work experience (average)
Team 1	4.82
Team 2	3.58
Team 3	3.61
Team 4	1.99

There was a small and insignificant positive correlation between company tenure and prior teammate work experience, $r = .293$ ($p = .175$).

Team Design/Role Understanding

For the role understanding questions, we looked at the actual role the person had in the team, the respondent's reported role, and how the respondent coded the other members of the team. The coding of the match or no-match here was done by two separate coders. The initial agreement was computed using Cohen's Kappa. The initial Kappa was $k = .804$ ($p < .001$). After some discussion about a particular set of results, Kappa increased to $k = .854$ ($p < .001$). This is a fairly high level of inter-rater reliability (Landis & Koch, 1977). For the research questions, the first rater's results were used.

Our survey showed that team members knew who the leader of the team was. In both T1 and T2, there was 100% recognition of the leader, and in T3 and T4, it was 67%. T3 is slightly more complex because there was both a technical lead and a business manager, so the uncertainty can be explained somewhat there. In addition, the surveys showed the leader generally knows his or her teams: In T1, T3, and T4, there is high recognition of roles (100% and 86%, respectively). Team 2 is an outlier, with the leader coding all of the other members of the team as "contributing members." This is likely a misunderstanding of the question.

An interesting case is in T3, Subject #303. The respondent is reasonably familiar with the other team members (71% role match), but the rest of the team has little knowledge about who the respondent is (17% role match). This individual also scored much worse on the "time worked with" in Section 4.1, suggesting that he was an outsider who was relatively unfamiliar to the team. Team 4 has a similar situation, Subject #407; unfortunately, Subject #407 was a non-responder, so team and company history are not available.

Process Knowledge

At both the initial and follow-up survey, the process knowledge inventory was administered. This is reported on a 0 to 4 scale, with higher numbers indicating a greater command and understanding of the processes. The basic descriptives are in Table 4.

Table 4
Process Inventory Descriptives

PROC1	Minimum	1.13	
	Maximum	2.80	
	Mean	2.19	*n*=16
PROC2	Minimum	.60	
	Maximum	2.60	
	Mean	2.20	*n* =20

The initial and follow-up scores were highly correlated to one another, $r = .81$ ($p < .01$), but there was no significant correlation to company or team tenure. There was no significant correlation on a per-team basis at the initial survey, but Team 2 had a strong negative correlation at the second survey, even controlling for the initial survey value ($r = -.56$, $p = .05$). No other teams had a similar correlation.

Team Trust

Time 1 Trust Values

The trust inventory results in a scale from 0 to 4, with higher values meaning a higher level of trust.

Table 5
Time 1 Trust Measure Descriptives

TRUST1	Minimum	0.77	
	Maximum	3.5	
	Mean	2.58	*n* = 16

These numbers are a little low, with nearly one in five of respondents averaging neutral or worse on the inventory. Slightly surprising was a slight negative correlation between the trust measures and time with the company, although this was not significant at the $p < .05$ level.

Time 2 Trust Values

The primary dependent variable in this investigation was the value of trust at the second survey point.

Table 6
Time 2 Trust Measure Descriptives

TRUST2	Minimum	1.27	
	Maximum	3.7	
	Mean	2.65	n = 19

Overall, trust went up at the second survey (2.58 to 2.65). The two trust values are highly correlated, r = .79 (p < .001). Most respondents (61.5%) went up in trust from the initial survey to the second survey, but there was still a reasonable percentage that went down (38.5%).

Factors Influencing Team Trust

The first research question was:

RQ1: Does having prior work experience with teammates help improve overall team trust?

To address this question, we looked at the prior history with teammates, controlling for the initial value of trust. This model was significant, and although prior work experience is just barely significant, it does influence team trust. However, as seen in Table 7, the sign of the coefficient for history is negative, reflecting an inverse relationship between prior history and trust. This means that a longer history with fellow teammates created less trust overall. Needless to say, this is not the outcome we were expecting, and this result can be attributed to various factors that are beyond the scope of this research.

Table 7
Effect of History With Company and Teammates on Final Trust, Controlling for Initial Trust

	Time 2 Trust	
	Step 1	Step 2
	β	β
Control Variables:		
Time 1 Trust	.790***	.683***
Main Effect:		
History with the Company		-.074
History with Teammates		-.366
Adj R^2	.59 ***	.69 ***

Note. N = 12
*** p < .01

The second surveys were given in September and October of 2008. During this time, there was significant economic turmoil in the nation and the world, the beginning of a significant labor dispute at the company, and major budget realignments within the organization. All of these factors could be a source of decreased trust among coworkers. In addition, the company has a history of layoffs, which would further decrease trust among coworkers. However, looking strictly at tenure with the company, we don't see any significance; so with the data at hand, there is no clear explanation for this finding.

Looking at the results for individual teams, there is no similar finding for a single team. The individual teams have a small *n*, which makes the reliability of the regression analysis suspect. Although the effect is there, with the overall small sample size, there remains a reasonable possibility that the effect is being driven by a few outliers. Future work on this is being planned to get a better sense of how prevalent and widespread this effect is in other teams.

RQ2: Does having good knowledge of the process and procedures the team will be following help improve overall team trust?

Looking at process and tool knowledge overall, we are unable to find any support for the hypothesis that greater knowledge of processes helps a team coalesce. As shown in Table 8, although the model is significant, the process component does not have any significant impact on trust

Table 8
Effect of Process Knowledge on Final Trust, Controlling for Initial Trust

	Time 2 Trust		
	Step 1	Step 2	Step 3
	β	β	β
Control Variables:			
Time 1 Trust	.790 ***	.834 ***	.728 ***
Main Effect:			
Process Knowledge at Time 1		-.287	.119
Process Knowledge at Time 2			-.387
Adj R^2	.59 ***	.60 ***	

Note. $N = 12$
$^{***}p < .01$

However, if we look at the individual components of the process inventory, a more detailed and complex picture begins to emerge. Table 9 shows the result of a model with each

component entered separately. As can be seen, the model is significant overall, and several of the components of process knowledge are individually significant in influencing trust in the team.

Table 9
Effect of Process Knowledge Components on Final Trust, Controlling for Initial Trust

	Time 2 Trust	
	Step 1 β	Step 2 β
Control Variables:		
Time 1 Trust	.790 ***	.663 ***
Main Effect:		
Process Knowledge at Time 2		
Group A		-.705 **
Group B		.095
Group C		-.202
Group D		-.096
Group E		.591 *
Adj R^2	.59 ***	.74 ***

Note. $N = 12$
* $p < .1$, ** $p < .05$, *** $p < .01$

Note that Group A (overall process knowledge) is a negative influence on final trust, and Group E (training) is a positive influence. The other groups are insignificant. This leads to an ambiguous understanding of RQ2: Some aspects of process knowledge help the team, but other aspects play no part or actively hurt the team. The discussion section will go into this finding in greater depth.

RQ3: Does knowing the roles and responsibilities of the other members of the team help improve overall team trust?

Here, we use the team understanding to see if there is any influence on the final trust. We were unable to find any support for the hypothesis that understanding the roles and responsibilities of the other members improves the final team trust; the factors in our model were not significant.

Table 10
Effect of Team and Role Understanding on Final Trust, Controlling for Initial Trust

	Time 2 Trust	
	Step 1 β	Step 2 β
Control Variables:		
Time 1 Trust	.790 ***	.692 ***
Main Effect:		
Role Understanding		-.144
Team Understanding		-.321
Adj R^2	.59 ***	.61 ***

Note. $N = 12$
$^*p < .1$, $^{**}p < .05$, $^{***}p < .01$

One comment in an interview was that on that specific team, an individual appointed him-/herself as a team leader although that individual was at the same management level as the other members of the team. It was suggested that it would have been better to bring in someone at a higher rank to lead the team.

Discussion

Team Selection Issues

Finding enough teams with managers who were willing to participate was not an easy task. The target teams, proposal capture teams, were often working under deadlines and managers tried to protect their team's time. Sometimes the managers did not see any value in the research, and declined to let their team participate in the work. In an effort to find enough teams, we went further afield from the original guidelines for the team, and found ones that were not necessarily following a well-defined process. Even experience with the capture teams suggested that the process was followed more in its breach than its observance.

This is the primary limitation of this research: the sample size is small, and generalization to other teams and industry contexts needs to be done very carefully. We are currently seeking opportunities to try to look at more teams within the company, and see if more strength can be found for the results presented here.

The Process Versus the Goal

In the interviews, a recurring refrain from the ground level was that the processes being used were "as clear as mud," and that, over time, the process was significantly changed each

time a new team was formed. For example, if previously the process had been executed in a bottom-up approach, this time around it would be driven in a top-down fashion. Even in the face of these significant changes to the process, the outcomes are not changed that much, nor are they that unpredictable. So what seemed to happen was that instead of focusing on the steps of the process, the members of the team instead focused on the goal as they saw it. Especially for individuals with long experience with the mutability of the processes, the interviews brought up a recurring focus on the final deliverables rather than the specific process gates and the intermediate work practice.

One leader remarked on trying to protect the individual contributors from the process. The leader understood the process and how the different contributors fit in, but made a conscious effort to insulate team members from the process to let them focus on their work. This meant that the leader took a greater role in coordinating and integrating the work. Not surprisingly these teams had a lower understanding of other team members' roles, but a higher final trust.

That being said, the findings in the process inventory versus trust seem to contradict this. Knowledge of the high-level process was negatively correlated to trust development, while there was limited support for tool knowledge helping the process. The tool knowledge may reflect the goals of the team leaders to protect their team from "details": the templates and tools help the team members complete the necessary tasks without having to know much more about the process. Perhaps, also, knowing too much about the process was a distraction for the individuals. There aren't clear implications on how to handle these issues. The obvious choice might be to have clear processes and tools and stick with them, but that is not always possible or even desirable. The approach taken by one of the leaders—to isolate the individual members from the overall process—may be one appropriate option, especially in smaller projects. This also may be a useful approach if the process is relatively new and still undergoing frequent revisions. The other insight here is that at the very least, the team should have a good sense of what their particular contribution is expected to be. This helps them understand what their task is and is not.

Process Versus Project

On a more fundamental level, it may be that the teams and processes imagined at the outset of this work simply don't exist. The idealized team for this research would have been one that was put together based primarily on expertise, had not worked together much previously, and were following a documented process. But, to use project management terminology, a *team* is put together to support a *project.* A project is a one-off activity, not expected to be repeated on a consistent basis. On the other hand, a *process* is something that is repeated on a regular basis. Best practice in industry is to manage processes very differently from projects, emphasizing repeatability and consistency. Projects are assumed to be fundamentally different from one another, and the goal is to manage to the objectives and constraints of the project. The teams that were selected in this work were much closer to project teams than process groups.

Based on other work the researchers have done on Change Control Boards (CCBs), we have identified some differences between project teams and process groups. Change Control Boards implement a change process, generally used to manage large projects or software systems. They are the gate-keepers and approvers for any change, and follow carefully

documented processes (frequently with specialized software to support them). The teams that implement processes work differently: the teams are more stable over time, and the teams are rarely put together all at once. Instead, the process group replaces people based on their role as openings occur, or as the tempo of the process group increases. In this context, many of the research questions asked by this research project are not as relevant because there is never a single opportunity for all members (or perhaps even a majority of members) to be new on the process group.

Proposed Further Work

This work suggests several possible directions for future work. The first is to get a better understanding of the differences between process-driven groups and project teams, and the role that processes help or hinder the project teams. Coupled with this work would be an effort to categorize processes and the different levels of process understanding and the impact of these on trust. The positive and negative correlations between different factors of process understanding on the trust measures suggest that there may be two underlying notions of process understanding, such as Feldman and Pentland's ostensive versus per formative organizational routines (Feldman & Pentland, 2003). A more detailed exploration of the understanding of the relationship between organizational routines and formal processes would help here.

The next possible direction is to get a better understanding of some of the negative influences on trust development on the teams. The result in RQ1, prior work experience negatively impacts trust development is quite unexpected and somewhat counter-intuitive for a reasonably well-performing organization. There is the possibility that this finding is unique to the organization surveyed, but it would require going out to other organizations, and possibly other types of organizations to determine if this is a fluke or not. A crucial gap in the present research was that although questions were asked about prior work experience and the source of that work experience, the questions were formulated to be relatively value-neutral and not elicit any positive or negative attitude towards the other team members. Refining the survey instrument to contain these kinds of questions might help to further explain these findings, and perhaps ways to ameliorate the problem. In addition, questions in the second survey on the satisfaction of the team experience, including team results might give more insight into the value of trust. However, this adds additional risk to the research: the teams should be organizationally further away from the investigators, and there should be heightened human subject review.

References

Feldman, M. S., & Pentland, B. T. (2003). Reconceptualizing organizational routines as a source of flexibility and change. *Administrative Science Quarterly, 48,* 94–118.

Hollingshead, A. B. (2001). Cognitive interdependence and convergent expectations in transactive memory. *Journal of Personality and Social Psychology, 81,* 1080–1089.

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics, 33,* 159–174.

McAllister, D. J. (1995). Affect- and cognition-based trust as foundations for interpersonal cooperation in organizations. *Academy of Management Journal, 38,* 24–59.

Meyerson, D., Weick, K. E., & Kramer, R. M. (1996). Swift trust and temporary groups. In R. M. Kramer & T. R. Tyler (Eds.), *Trust in organizations: Frontiers of theory and research,* (pp. 166–195). Thousand Oaks, CA: Sage.

Appendix A: Survey Instrument (Time 0)

Prior Knowledge and Team Formation

This study looks at the impact of prior knowledge of team members and business processes, as well as leadership styles, on the success of team formation. There are two written surveys during the study period; this is the first of the two surveys.

There are four sections to this survey. Please answer each section in order to the best of your ability. There are no right or wrong answers, and all answers will be kept confidential during the study period. You may skip any question. Once the study period is over, the answers will be made completely anonymous.

Please fill out the survey with Adobe reader. This is faster for you to complete the survey. It also makes making the results anonymous easier at the end of the study period. If you cannot complete the survey using Adobe reader, print out the survey and answer it on paper.

Please return the completed survey to:
Mark Handel

If you have any questions about the survey or the research, please contact Mark Handel.

Section 1: About Yourself

1. How long have you been at Boeing?

a. Less than a year
b. 1 to 3 years
c. 3 to 5 years
d. 5 to 10 years
e. 10 or more years

2. What is your role on the team?

Free response area

3. How did you join this team?

Free response area

4. How long have you been on this team, in any capacity?

a. Less than a week
b. 1to 2 weeks
c. 2 weeks to a month
d. 1 month to 2 months
e. 2o months or longer

Section 2: Process Knowledge/Understanding

The following questions ask about the processes and procedures that you work to on a daily basis. If you work to several processes on a daily basis, please pick the one that you do *most often* in relation to the team on which you are working. If you are unclear about a question, please choose "not applicable."

Please work quickly, and record your most honest impression to each statement.

Fill in the appropriate radio button.

For each item a 5 point Likert scale (Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree) plus "Not Applicable" was provided.

1. The process I use makes sense to me.
2. Much of my work is exceptions to or gaps in the process.
3. The process can be improved to better match what I do on a daily basis.
4. I know the policies, procedures, and processes that document the work I am doing.

5. The process I am using and the step(s) I follow are well-established within the company.
6. I know how my process fits in within the larger business unit and business goals.
7. I have to refer to process documentation as a reminder of details of how to execute work.
8. Coworkers frequently ask me how to handle situations related to the process.
9. I can tell what the next step in the process is.
10. I had sufficient formal training on the process prior to starting work.
11. A new employee should spend time in the available classes and/or read the documentation rather than jump right in and ask questions as needed.
12. It takes a while doing the work before it comes naturally.
13. I regularly use the supplied computer system(s) (e.g., web-based application, specialized forms) to work the process.
14. I frequently find differences between how the computer system(s) work and the way the process is defined.
15. I have to use informal systems (e.g., Excel spreadsheets, new templates) to address gaps or exceptions.

Section 3: Other Members of Your Team

You will be asked about the individual members of the team, by name. Please answer the questions to the best of your ability; however, do not reveal any confidential information. If an important member of the team has been left out, there are two blank sub-sections at the end for you to fill out.

Do not answer the section on yourself.

Again, these responses will be kept confidential.

For each member of the team, there was a single page with the following questions. In addition, there were two blank pages with the same questions, but no name filled in for the respondent to use. There were no situations where a team member was added by a respondent.

Individual: (*Name Printed)*

1. Do you know or have you worked with this person before?
    a. No prior knowledge of this team member.
    b. Know this member by reputation only (see Question #2).
    c. Limited work experience.
    d. Prior teams with this team member.
    e. Extensive prior work experience with this team member.

2. If you know this member by reputation, please indicate the general source of this information (e.g., “coworker worked closely with individual,” “biography on corporate intranet,” etc.)

Free Response Area

3. Please describe the role of this person on your team, to the best of *your* knowledge.

Free Response Area

Section 4: Team Formation

Please answer the following questions about the team. If you added additional people in Section 3 above, please answer the questions about all members of the team, not just the ones already supplied. If you do not have enough experience with your team to answer the question, please select "Insufficient knowledge."

Please fill in the appropriate radio button.

For each item a 5 point Likert scale (Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree) plus "Not Applicable" was provided.

1. Our team has a sharing relationship. We can all freely share our ideas, feelings, and hopes.
2. I can talk freely to my team about difficulties I am having at work and know that overall they will want to listen.
3. The team would feel a sense of loss if a member was transferred and we could no longer work together.
4. If I shared my problems with the team, I know they would respond constructively and caringly.
5. I would have to say that our team has made considerable emotional investments in our working relationship.

For the following questions, answer them about the *other* members of your team.

Please fill in the appropriate radio button.

For each item a 5 point Likert scale (Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree) plus "Not Applicable" was provided.

1. The other members of the team approach their jobs with professionalism and dedication.
2. Given the members of the team's track record, I see no reason to doubt their competence and preparation for the job.
3. I can rely on the team not to make my job more difficult by careless work.
4. Most people, even those who aren't close friends of the team members, trust and respect the other members as coworkers.
5. Other work associates of mine who must interact with the team consider the other team members to be trustworthy.
6. If people knew more about the team and their background, they would be more concerned and monitor their performance more closely.

Appendix B: Survey Instrument (Time 1)

Prior Knowledge and Team Formation

This study looks at the impact of prior knowledge of team members and business processes, as well as leadership styles, on the success of team formation. There are two written surveys during the study period; this is the first of the two surveys.

There are four sections to this survey. Please answer each section in order to the best of your ability. There are no right or wrong answers, and all answers will be kept confidential during the study period. You may skip any question. Once the study period is over, the answers will be made completely anonymous.

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Please return the completed survey to:
Mark Handel

If you have any questions about the survey or the research, please contact Mark Handel.

Section 1: About Yourself

1. How long have you been at Boeing?
    a. Less than a year
    b. 1 to 3 years
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    d. 5 to 10 years
    e. 10 or more years

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The following questions ask about the processes and procedures that you work to on a daily basis. If you work to several processes on a daily basis, please pick the one that you do *most often* in relation to the team you are working. If you are unclear about a question, please choose "not applicable."

Please work quickly, and record your most honest impression to each statement.

Fill in the appropriate radio button.

For each item a 5 point Likert scale (Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree) plus "Not Applicable" was provided.

1. The process I use makes sense to me.
2. Much of my work is exceptions to or gaps in the process.
3. The process can be improved to better match what I do on a daily basis.
4. I know the policies, procedures and processes that document the work I am doing.
5. The process I am using and the step(s) I follow are well-established within the company.
6. I know how my process fits in within the larger business unit and business goals.
7. I have to refer to process documentation as a reminder of details of how to execute work.
8. Co-workers frequently ask me how to handle situations related to the process.
9. I can tell what the next step in the process is.
10. I had sufficient formal training on the process prior to starting work.
11. A new employee should spend time in the available classes and/or read the documentation rather than jump right in and ask questions as needed.
12. It takes a while doing the work before it comes naturally.
13. I regularly use the supplied computer system(s) (e.g. web-based application, specialized forms) to work the process.
14. I frequently find differences between how the computer system(s) work and the way the process is defined.
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Section 3: Other Members of Your Team

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Do not answer the section on yourself.

Again, these responses will be kept confidential.

[For each member of the team, there was a single page with the following questions. In addition, there were two blank pages with the same questions, but no name filled in for the respondent to use. There were no situations where a team member was added by a respondent.]

Individual: (*Name Printed)*

1. Do you know or have you worked with this person before?

a. No prior knowledge of this team member.
b. Know this member by reputation only (see Question #2).
c. Limited work experience.
d. Prior teams with this team member.
e. Extensive prior work experience with this team member.

2. If you know this member by reputation, please indicate the general source of this information (e.g., "co-worker worked closely with individual," "biography on corporate intranet," etc.).

Free Response Area

3. Please describe the role of this person on your team, to the best of *your* knowledge.

Free Response Area

Section 4: Team Formation

Please answer the following questions about the team. If you added additional people in Section 3 above, please answer the questions about all members of the team, not just the ones already supplied. If you do not have enough experience with your team to answer the question, please select "Insufficient knowledge."

Please fill in the appropriate radio button.

[For each item a 5 point Likert scale (Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree) plus "Not Applicable" was provided.]

1. Our team has a sharing relationship. We can all freely share our ideas, feelings, and hopes.
2. I can talk freely to my team about difficulties I am having at work and know that overall they will want to listen.
3. The team would feel a sense of loss if a member was transferred and we could no longer work together.
4. If I shared my problems with the team, I know they would respond constructively and caringly.
5. I would have to say that our team has made considerable emotional investments in our working relationship.

   For the following questions, answer them about the *other* members of your team.

   Please fill in the appropriate radio button.

1. The other members of the team approach their jobs with professionalism and dedication.
2. Given the members of the team's track record, I see no reason to doubt their competence and preparation for the job.
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